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By Col. R. H. Elliot, I.M.S.

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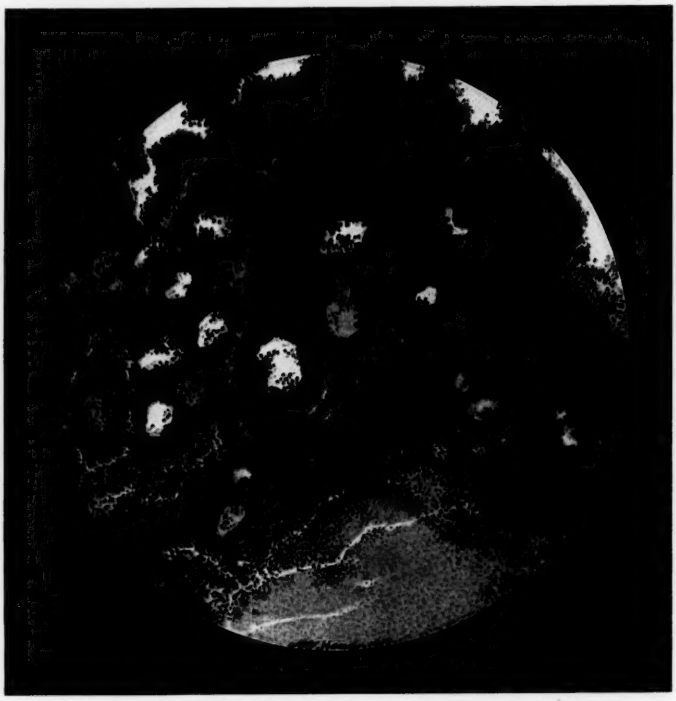

Fig. 1. General view of tumour showing cells arranged around vessels and spaces. × 90.

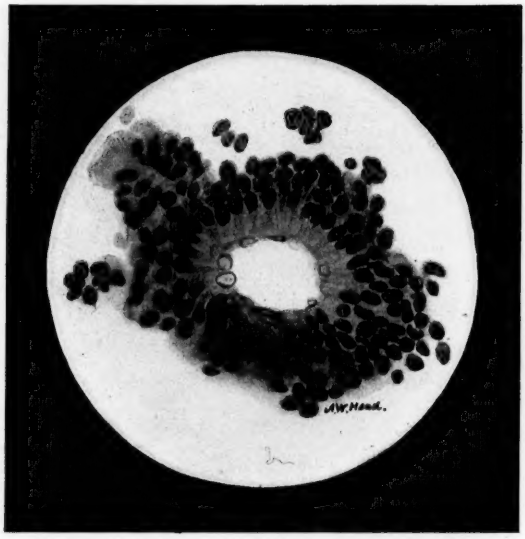

Fig. 2. Showing rosette of Wintersteiner. × 390.

THE BRITISH JOURNAL
OF
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AUGUST, 1919

COMMUNICATIONS

A CASE OF BILATERAL GLIOMA OF THE RETINA IN A GIRL TWENTY YEARS OF AGE IN WHICH THE SECOND EYE WAS EXCISED AFTER AN INTERVAL OF NEARLY EIGHTEEN YEARS

BY

CHARLES MAGHY, M.D.

CURATOR AND PATHOLOGIST, ROYAL LONDON OPHTHALMIC (MOORFIELDS) HOSPITAL.

History.—Patient, G.M., female, twenty years of age, single, in good health, had a series of fits during the summer of 1913, two or three each week, for a period of three months. On Christmas day, 1913, her left vision failed rather suddenly while at church and patient was led home. Four days later, the family doctor was consulted and attended patient at intervals until October the following year. The family history was negative.

On admission to the Royal London Ophthalmic Hospital, October, 1914, the left eye was quiet, slight corneal haze present, but no "keratitis punctata" was seen. The anterior chamber was of normal depth and the aqueous clear. The pupil was circular and active. The iris, however, showed a few fine blood-vessels on its surface. The lens was opaque. Vision equalled hand movements and projection was quick and accurate. T. +1. On October 9, Mr. J. Herbert Fisher performed a linear extraction under

cocain. The following day the eye showed some oedema of the cornea and the pupil was dilated. T. full. Eserin ¼ per cent. contracted the pupil, but the tension remained normal for a few days only, and on October 20, a posterior sclerotomy was performed. A few days later the nasal field was found to be defective, a deposit resembling "keratitis punctata" developed, the cornea became hazy, and the tension was again plus. In December, a whitish granular deposit, which on microscopical examination showed cells resembling degenerated mononuclear leucocytes, settled to the bottom of the anterior chamber. Haemorrhage from the iris accompanied the paracentesis. Following a needling, the vision with a plus 12.00 D. sphere equalled 6/60 and with a plus 15.00 D. sphere, J.19. On March 9, 1915, the patient was discharged from the hospital, the vision now being reduced to the counting of fingers. Repeated operative measures failed to reduce the tension, but it was not until March, 1918, that the patient had severe pain. The eye was excised on May 17, 1918.

Right Eye.—The following is taken from the records of Moorfields Hospital, relative to the patient's right eye. "Admitted to hospital, July 7, 1900, on account of trouble with her right eye. Anterior parts of eye normal, with the exception that the anterior chamber is shallower than in the left. By oblique illumination a three-lobed mass was seen lying far back in the vitreous cavity with blood-vessels coursing over same. No reflex present. T. +1. Vision equalled P.L. Vitreous cavity nearly filled with a white flocculent growth. Anterior chamber almost obliterated. Lens yellow and misshapen. Posterior surface drawn back to a peak at point where retina passes back to optic nerve. Retina detached at seat of growth. Choroid in situ, optic nerve apparently not infiltrated. *Macroscopical report.*—Eyeball shows exophytic growth. At one spot layers of retina seem to be involved. Growth seems to spring almost entirely from inner nuclear layer. Inner granular layer invaded, also ganglion cell and nerve fibre layers. Cells grouped around blood-vessels. No rings of cells. Little degeneration."

Left Eye.—Pathological report on eye excised May 17, 1918. *Macroscopical.*—The left globe measured about 23 mm. by 22·5 mm. A staphyloma was present at the temporal side of the cornea, which extended backward about 6 mm. to 7 mm. The cornea showed a few fine nebulae peripherally, the central portion being quite clear. The iris appeared normal and the pupil was about 5 mm. in diameter and round, although slightly eccentric up and out. The aqueous was only faintly clouded. No lens present, but a strand of greyish tissue occupied its place. A grayish mass could be seen in the vitreous cavity. On section of the globe the vitreous was very fluid and contained a whitish deposit. The retina was not recognizable except at the anterior parts of the globe. The tumour extended forward to within

a few mm. of the lens capsule, but did not completely fill the cavity.

Microscopical.—Haematoxylin and eosin and Mallory's connective tissue stain. Cornea: This structure as a whole was thinned. The epithelium was absent in places, but otherwise was normal. Bowman's membrane was intact throughout. The stroma, although thinned, showed little evidence of inflammatory changes. Anterior chamber. —The conformation of the angle was changed as the root of the iris was in contact with the posterior surface of the cornea. The cells at the angle stained faintly and were probably degenerated leucocytes. A few glioma cells were also present. Iris.—This structure was more or less uniformly atrophic. On the posterior surface the pigment was heaped up into irregular patches at some places, while in others it was entirely missing, being attached to the lens capsule. Ciliary Body.—Contained glioma cells and was atrophic. Vitreous cavity.—The growth as a whole was quite vascular and was composed chiefly of cells that stained deeply with haematoxylin. No pigment was to be seen throughout the growth; areas of cellular degeneration were occasionally found. The cells immediately surrounding the blood-vessels stained deeper than those situated peripherally, and at the extreme periphery of the so-called rosettes of Flexner and Wintersteiner beginning cell necrosis was in evidence. The retina at the posterior part of the globe was entirely destroyed by the growth. In the anterior parts it was invaded with glioma cells and was very atrophic. The choroid was also atrophied and in places was only indicated by a dark line. The optic nerve was not involved outside the globe.

The portion of the tumour that was extrabulbar, in contrast to the intrabulbar portion, showed pigment changes and did not stain as uniformly. The vascular spaces were also much less clearly defined. The rosette appearance, so common in glioma of the retina, was lacking.

Remarks.—The case is of interest on account of the period that has elapsed between the excision of the two eyes, there being no case on record where the age of the patient exceeded 17 years. Fuchs mentions a case between 15 and 16 years of age (Fuchs's *Text-Book*, 5th Edition, p. 597).

In Lawford and Collins's series of sixty cases of glioma of the retina (*Ophth. Hosp. Reports*, Vol. XIII, p. 15), 6 to 7 years is given as the maximum age at the time of the excision. The literature covering 120 cases from this hospital does not show that a single case reached the age of 8 years.

The *American Encyclopedia of Ophthalmology*, Vol. VII, p. 5,583, states "Glioma is a disease of childhood, no true case having been found after the sixteenth year. Cases heretofore reported of greater age have been found to be either sarcomas of the choroid or pseudo neuro-epitheliomata."

Wintersteiner mentions a case in his book (*Das Neuro-epithelioma Retinae*, 1897) cited by Pepper, No. 194, p. 348, in which the patient was 17 years of age, and the duration seven months.

The patient has not had a recurrence in the orbit or metastasis elsewhere, so far as is known at this period, although thirteen months have elapsed since the second eye was excised.

I am indebted to Mr. J. Herbert Fisher for permission to publish the case.

THE MONTGOMERY LECTURE, 1917-18*

A survey of cases of concomitant squint in the practice of the late Mr. P. W. Maxwell.

BY

EUPHAN M. MAXWELL, M.B.,

DUBLIN.

AN article entitled "Precision in Squint operation" was published by Mr. Maxwell in the *Lancet*, 1896. The conclusions arrived at were based on a survey of two hundred cases. The author described a "muscle tucker" of his own design, but his practical experience of the instrument was then limited to three cases.

In 1908, he published an article "Internal Squint" in the *Medical Press and Circular*. This paper dealt mainly with Donder's theory of the aetiology of concomitant convergent squint, and contained no statistics of cases. No further record of his work was published, but up to the time of his death in 1917, the subject received his closest attention, and he was indefatigable in his efforts to perfect his operative technique.

There already exists a copious literature on concomitant squint; my excuse for adding to it is that a survey such as the following, though it embraces no new conceptions, may prove of value if it but strengthens existing theories and acknowledged lines of treatment.

Since 1896, 1,201 cases of concomitant squint are recorded amongst Mr. Maxwell's private and hospital patients. Of these, 1,121 were convergent, 179 divergent, and one an upward squint unaccompanied by lateral deviations. Fortunately I have been able to follow up several of these cases, and thus to complete their records.

I.—*Convergent concomitant squint*

An estimation of the average age of commencement showed: Constant and unilateral, 3.6 years; alternating, 3.4 years; periodic, 2.8 years; periodic becoming permanent, 4.5 years.

*Delivered in the School of Physic, Trinity College, Dublin, on Friday, Nov. 8, 1918.

An estimation of the average refraction of all the cases examined within a year or two of the commencement of the squint, excluding myopes with corneal nebulae, showed the following amount of hypermetropia in the lower and higher meridians of the squinting and fixing eyes respectively:

	Squinting eye.		Fixing eye.	
Constant and unilateral	l.mer. 3.5 D.Hy.	h.mer. 4.75 D.Hy.	l.mer. 3.5 D.Hy.	h.mer. 4.25 D.Hy.
Periodic	3.75 D.Hy.	4.5 D.Hy.	3.5 D.Hy.	4.25 D.Hy.

Only five cases examined under puberty showed myopia of both eyes; in these the convergence commenced within the first six months of life. Worth has noted this development of a convergence rather than a divergence in infantile myopes.[11] The average refraction in untreated cases under ten years of age, estimated in respect to the size of the "longe" angle was

	Under 10° L	10°-20° L.	21°-30° L.	Over 30° L.
Constant convergence	4 D.Hy.	4 D.Hy.	4 D.Hy.	4.25 D,Hy.
Periodic convergence	3 D.Hy.	4.5 D.Hy.	5.25 D.Hy.	6.75 D.Hy.

The refraction here noted was that of the fixing eye; where astigmatism was present the amount was halved and added to the lower meridian.

An increase in the amount of hypermetropia with an increase in the size of the angle was only noted in the case of the periodic squints where the refractive error is theoretically the sole causal agent. In these periodic cases, where the angle was small, or of medium size, 1 D. Hy. corresponded roughly to 3° of squint. That this correspondence ceased in the higher angles, is presumably due to the introduction of the secondary actions of the superior and inferior recti.

In 65 per cent. of cases under ten years of age the "prox" deviation was found greater than the "longe," only 45 per cent. of cases over ten years of age showed this relationship. These figures suggest a decrease, with advancing years, in the neuro-muscular activity associated with convergence.

Numerous instances of an absolute increase in both the "longe" and "prox" deviations up to puberty were noted.

The following were recorded as precipitating agents:—

Fright.	Illness.	Trauma of the eye itself.	Trauma or operation in the neighbourhood of the eye.	The wearing of a bandage for some weeks.
26 cases...	26 cases...	5 cases...	6 cases...	1 case (this occurred in a boy of 9 who had suffered from corneal ulceration).

Two of the cases precipitated by illness were of especial interest in that squints, cured in early youth by glasses and operation respectively, recurred some years later following the onset in one case of peritonitis, in the other of disseminated sclerosis.

The following complications were recorded :—

Nystagmus.	Well-marked vertical deviations.	Congenital ocular defects.	Ptosis.	Mental defects.
22 cases ...	16 cases ...	7 cases ...	5 cases ...	4 cases

The nystagmus was mainly bilateral and horizontal in type. The vertical deviations were upward in 14 cases, downward in two. In one of the former slight paresis of the superior rectus was noted. The congenital defects were cataract (4 cases), bilateral coloboma of iris (1 case), pigmented maculae (1 case), bilateral absence of choroidal pigment (1 case). Four of the 5 cases accompanied by ptosis showed the defect in the squinting eye only.

II.—*Divergent concomitant squint*

An estimation of the age of commencement in the cases of constant concomitant divergence, irrespective of the associated type of refraction, showed $7\frac{1}{2}$ years. Where the divergence was only periodic in type, the age at which the defect became noted appeared to vary with the type of refraction, where accompanied by a bilateral hypermetropia being noted at an earlier age than where accompanied by a bilateral myopia.

Eighty-three cases, where the type of refraction was the same in both eyes, showed :

Myopia, 48 cases ; hypermetropia, 28 cases ; mixed astigmatism, 7 cases.

An estimation of the amount of the refractive error, irrespective of age, in the lower and higher meridians of the squinting and fixing eyes respectively, showed :—

	Squinting eye.		Fixing eye.	
Constant divergence	*l. Mer.*	*h. mer.*	*l. mer.*	*h. mer.*
assoc. with myopia both eyes	8 D.My.	10·75D.My.	5 D.My.	7·75D.My.
Periodic divergence ditto	7 D.My.	9·25D.My.	5·25D.My.	6·75D.My.
Constant divergence assoc. with hy. both eyes	1·75D.Hy.	2·75D.Hy.	1·75D.Hy.	2·75D.Hy.
Periodic divergence ditto	1·25D.Hy.	2 D.Hy.	1·25D.Hy.	1·75D.Hy.

An estimation of the refraction in relation to the size of the

angle in the myopic cases suggested that the larger angle was associated with the greater anisometropia. No relationship between the size of the angle and the amount of the refractive error was noted in the hypermetropic cases.

An estimation of the type of refraction in relation to the respective sizes of the "longe" and "prox" angles showed:

	Hy. both eyes.	My. both eyes.
"Longe" greater than "prox" ...	20 cases ...	5 cases
"Longe" less than "prox" ...	4 cases ...	14 cases

This preponderance of hypermetropes in cases of "divergence excess" and of myopes in cases of "convergence insufficiency" agrees with the findings of Wooton of New York.[10]

As regards precipitating agents several cases were recorded where illness acted directly as such. Fright was recorded in 4 cases. Two cases of "consecutive divergence" were noted. In both these cases an eye, previously convergent, became divergent about the age of 7 years.

As regards complications 4 cases with marked vertical deviations were noted, 3 showed an upward and 1 a downward deviation. In the latter was noted slight paresis of the superior rectus. Two instances of divergence occurring in imbeciles, and one in an epileptic, were recorded.

III. The following is a brief outline of *the methods of examination and lines of treatment* adopted, where feasible, in the cases of *concomitant convergent squint:*

(1) The deviation and fixation angle were measured at the perimeter. Gross defects in outward mobility, and any complications present, were recorded.

(2) After an instillation of 1 per cent. atropin into both eyes for ten days, the deviation was again measured and retinoscopy done.

(3) Glasses were then ordered, the spherical correction being 0.5 D. less than, the astigmatic correction being exactly that of, retinoscopy. Where the hypermetropic error was high, atropin was continued in both eyes until the glasses had been worn for about a fortnight.

(4) Where fixation was faulty, or vision defective, despite optical correction in the squinting eye, atropin in, and occlusion of, the fixing eye was continued for some weeks. Occlusion, in the very young, was only practised during part of the day, preferably at meal-times.

(5) Where the squint still persisted after some months of above treatment, operative measures were introduced.

(6) Orthoptic exercises were mainly employed as a post-operative measure.

Certain points of interest elicited in the examination of these cases are here recorded:

(1) The average reduction of the "longe" angle by atropin, estimated in respect to the age of the patient, and the length of time of dosage, and in comparison with the reduction effected by glasses, was as follows:

Average reduction under 10 years, 6°	10-15 years, 4·6°	over 15 years, 2°
Average reduction, irrespective of age, when given from 1-3 days, 2° ...	4-7 days, 2·5°	over 7 days, 11·6°
Average reduction, irrespective of age or dosage, with atropin	under 10 years, 6·8°	over 10 years, 5·7°
Average reduction with glasses	15·9°	8·6°

The decreasing effect of age is presumably the result of decreasing hypermetropia.

In estimating the result of dosage, several instances of an increase in convergence and a decrease in divergence, where atropin had only been instilled two or three times, were noted. This was presumably the result of an increased accommodative activity called into play on account of faintly responsive muscles. That the reduction with glasses was greater than with atropin may be largely explained by the fact that many of my figures were taken from patients who had been wearing glasses for some months. Mr. Maxwell has estimated the immediate and remote effects of glasses as being in a ratio of 3 : 5·5.[6] The still greater relative increase with glasses in children under 10 years, may have been partly due to the added effect of occlusion of the fixing eye, recorded in many instances, this effect being apparently more marked in younger children. I noted eight cases which were recorded as "straight" under atropin. Seven of these became cured with glasses, the eighth, examined some months later, still showed a slight convergence for "prox."

(2) The average fixation angle was 3° out in the squinting, and 4°, in the fixing eye.

Amblyopic vision in the squinting eye was found to exist where the angle was less than 1° or more than 7° out. A vision of "motion of hand" was recorded in one case with marked eccentric fixation. Where fixation was faulty, the average age of commencement of the squint was found to be 1½ years; this agrees with Priestley Smith's view, as quoted by de Schweinitz, that all infants are amblyopic, and that an early developing squint may readily hinder the further progress of the eye.[7]

Several instances of a travelling inwards of the fixation point

after treatment, even where some convergence still persisted, were noted. This has been explained as showing an attempt on the part of the squinting eye to co-operate better with its fellow.[6]

3. Binocular vision was found present in every case of periodic squint, where looked for. In the cases of constant squint its presence or absence was usually recorded after treatment. The following table shows the average ages at which treatment was undertaken, in the cases where a complete, partial, or absent binocular vision was noted:

Complete binocular vision.		Partial binocular vision.		Binocular vision absent.
4½ years.	...	7⅓ years.	...	8½ years.

Guided by Worth's experience[11] we may assume that the majority of cases recording partial binocular vision after 7 years of age had had a fusion sense before treatment, but in too weak a degree to prevent the squint. Eight of these cases with partial binocular vision still showed slight convergence when tested. In one or two instances where a sense of perspective was wanting, bar-reading and accuracy with the Hering drop test were noted. One case of a boy of 16 years of age who showed complete binocular vision after a successful operation, was presumably an illustration of fusion memory, as in early life his squint had been cured with glasses but had recurred a year or two later on discarding the latter.

About 40 per cent. of cases showing binocular vision after treatment, optical or operative, became straight without glasses at an early age. In no instance where complete binocular vision was noted, did the corrected vision of the squinting eye fall below 6/12.

4. Diplopia as a symptom was only recorded in 1·5 per cent. of cases. The average age of commencement of the squint in these cases was 11 years.

In 36 per cent. of cases in which binocular vision was noted absent, diplopia was recorded as having been readily elicited. I had several opportunities during such examinations of noting the power of the vertical prism to overcome suppression, over coloured glasses.

In 87 per cent. of cases where diplopia was recorded either as a symptom, or as having been artificially produced, the corrected vision of the squinting eye was above $\frac{6}{36}$. Several instances were noted of the post-operative development of crossed diplopia, in cases where the eyes were straight, or where some convergence still persisted. These cases have been explained as demonstrating the existence of a new fovea, or, in the absence of co-ordinating points in the retinae, of the power of each eye to localize for itself more or less correctly.[7]

In some few cases with homonymous diplopia in which I was

able to measure the distance between the images, I found an average equalling roughly one-third of the deviation.

Certain points of interest in connection with the results of optical treatment are here recorded:

	Under 10 years of age.	Over 10.
Average reduction "longe" with glasses	12·5°	6·9°
Average refraction of fixing eye ...	4·25 D. Hy.	2·75 D. Hy.

This averages a reduction of about 3° of squint by every corrected dioptre of hypermetropia. The figures were taken from cases which had only been wearing glasses for a few weeks. Where astigmatism was present the amount was halved and added to the lower meridian.

In the following tables "cosmetic cure" implies a remaining convergence of less than 3°, including the fixation angle; under this heading are also included cases which became straight "longe" but remained convergent "prox."

	Perfect cure.	Cosmetic cure.	Not cured by glasses.
Average age of treatment	5½ years.	8 years,	9 years.
Percentage of results	30 per cent.	20 per cent.	50 per cent.
Spherical correction given to within 1 D. of retinoscopy.	100 per cent.	100 per cent.	88 per cent.
Astigmatic correction ditto	75 per cent.	75 per cent.	64 per cent.
Occlusion recorded as supplementary treatment.	25 per cent.	18 per cent.	12 per cent.
Binocular vision present, in cases where looked for, after treatment.	100 per cent.	56 per cent.	70 per cent.
Faulty fixation before treatment ...	20 per cent.	25 per cent.	35 per cent.
Squint amblyopia	25 per cent.	45 per cent.	45 per cent.

These figures were taken from cases which had been given a genuine trial, for several months, with glasses. Two or three cases were recorded in which, showing little improvement with an under-correction of their refraction, they became straight or very much reduced, on being given an accurate correction. 30 per cent. of the "perfect cures" were periodic in type. 18 per cent. of the constant cases noted "perfect cures" became straight without glasses, within a year or two of wearing them.

The high percentage of cases showing binocular vision amongst the "non-cures" may be accounted for by the fact that many of

these cases later underwent, and were cured by, operation, the fusion sense being looked for at the completion of treatment.

In the following table are recorded certain points of interest in connection with the results of optical, combined with operative, treatment:

	Perfect cure.	Cosmetic cure.	Still converging.	Diverging.
Average age of treatment.	Gl.; 7 years Op.: 8½ ,,	Gl: 7½ years Op: 10½ ,,	Gl.: 7 years. Op.: 9½ ,,	Op.: 11 years.
Percentage of results.	36 per cent.	26 per cent.	29 per cent.	9 per cent.
Alternating squint.	12 per cent.	13 per cent.	28 per cent.	
Occlusion recorded as supplementary treatment.	35 per cent.	14 per cent.	12 per cent.	
Binocular vision present in cases where looked for, after treatment.	84 per cent.	42 per cent.	0 per cent.	50 per cent.
Of the cases presenting diplopia as a pre-operative symptom.	85 per cent.	15 per cent.		
Diplopia as a post-operative symptom.	36 per cent.	40 per cent.	12 per cent.	12 per cent.
Faulty fixation before treatment.	8 per cent.	25 per cent.	70 per cent.	20 per cent.
Squint amblyopia.	12 per cent.	50 per cent.	46 per cent.	55 per cent.

These figures were taken from cases, seen during a period of four years on an average, after the last performed operation.

Only 20 per cent. of the "perfect cures" required a second operation. 35 per cent. of the "perfect cures" were found straight without glasses within two or three years of the operation, that is, on an average, about puberty.

None of the "divergences" with binocular vision had a sense of perspective.

Amongst the cases marked "still converging" were noted one mentally defective, three accompanied by nystagmus, several accompanied by marked altitudinal displacements, and three which showed considerable variation in the size of the angle, examined on different days. These last-mentioned cases had presumably a marked neurotic element, rendering successful treatment more difficult.

IV.—*The methods of examination and lines of treatment* adopted in the cases of *divergent squint*, accompanied by myopia, were

roughly those outlined under convergent squint. When accompanied by emmetropia or hypermetropia, there were no general lines of treatment which could be recorded.

Certain points of interest elicited in the examination of divergent squints are here noted:

(1) The average fixation angle was 4·25° out in the squinting, and 5° out in the fixing eye.

Amblyopic vision in the squinting eye was found to exist in every case where the angle was less than 2°, and in the one case where it was more than 10° out.

Not very many instances of faulty fixation were noted, presumably owing to the usually late development of divergent squint. A travelling inwards of the fixation point after operation was recorded in four cases.

(2) Binocular vision, in some degree, was found present in most of the cases where looked for. This may partly account for the fact that more complete and rapid results with orthoptic exercises and occlusion of the fixing eye, appear to have occurred in divergent than in convergent squints. In one case of alternating divergence, a well-developed sense of perspective was recorded. No case with a fusion sense had a corrected vision below 6/24.

(3) Diplopia as a symptom was recorded in 12 per cent. of cases; most of these were associated with bilateral myopia.

In 85 per cent. of cases where diplopia was recorded either as a symptom or as having been artificially produced, the corrected vision of the squinting eye was above 6/24.

In 65 per cent. of cases which became straight after operation, and in which diplopia was noted as a post-operative symptom, the diplopia was homonymous in character.

In the cases with crossed diplopia, where the distance between the images was measured, it was found to equal roughly, on an average, half of the deviation.

In regard to the general results of treatment the following points are of interest:

The few cases which were recorded as cured or improved with glasses showed myopia in both eyes with a convergence insufficiency.

In all of them good fixation and corrected vision were noted. Diplopia was recorded as a symptom in the majority of these cases.

One instance was noted where a divergence, but little affected by under-correcting concave glasses, became straight, when the patient was given the full correction.

In the following table, in connection with operative results, "cosmetic cure" implies a remaining divergence of less than 10°, including the fixation angle.

	Perfect cure.	Cosmetic cure.	Still diverging.	Converging.
Average age of treatment ...	24 years.	11 years.	17 years.	
Percentage of results	36 per cent.	30 per cent.	17 per cent.	17 per cent.
Binocular vision present, in cases where looked for, after treatment	100 per cent.	—	100 per cent.	50 per cent.
Diplopia as pre-operative symptom	68 per cent.	0 per cent.	32 per cent.	25 per cent.
Diplopia as post-operative symptom	40 per cent.	60 per cent.	—	100 per cent.
Faulty fixation before treatment	0 per cent.	25 per cent.	35 per cent.	25 per cent.
Squint amblyopia	25 per cent.	25 per cent.	75 per cent.	0 per cent.

These figures were taken from cases seen during a period of three years, on an average, after the last operation.

Only 25 per cent. of "perfect cures" needed a second operation. All the cases marked "still diverging" were operated on more than once.

(To be concluded)

THE VISUAL PERCEPTION OF SOLID FORM*

BY

E. M. EATON.

IT is almost universally accepted that the binocular element is the essential factor in stereoscopic vision. Several of the attributes of uniocular vision have long been recognized as contributing to the impression of relief, or to the sense of depth, but it is generally considered that the vision obtainable by such means differs in a peculiar essential from that which has the quality described by Sir Charles Wheatstone as stereoscopic. I am convinced that this view is erroneous, and in the following paper I hope to satisfy you that it has no justifiable foundation.

What is the essential quality? It is difficult to obtain agreement on this question, for it concerns a subtlety of personal experience that

* Read before the Ophthalmological Section of the Royal Society of Medicine on June 4, 1919.

perhaps cannot with fulness be expressed in words. I shall, however, endeavour to answer it in some measure, and shall explain why I think I am justified in saying that the stereoscopic quality is not an exclusive attribute of binocular vision. This will involve a restatement of the principles of binocular fusion on a basis of less intimate organization of the two eyes than that commonly assumed.

As we have to deal with a particular quality of visual feeling, it will be of interest to consider first some of the analogies with the other senses. Every sensation which tells us anything of the outer world, be it a sensation of hearing, of sight, or of any other kind, consists of two parts between which a definite demarcation can be made; there is a physical sense impression with its associated primitive feeling quality, and there is a modification of consciousness which has a reference to the object that gives rise to the sense stimulus. The former is independent of our experience, and is determined by the fixed attributes of our sensory mechanism; thus, heat and cold, high pitched notes and low pitched notes, red light and blue light, all give rise to specific qualities of feeling which are inevitable in character; that is, they are such that we cannot by any process of thought make a choice in the type of feeling which is aroused by them, nor can we even conceive the possibility of our having any such choice. On the other hand, if when we hear a certain sound we immediately become aware of the passing of a railway train, the state of consciousness established is not an inevitable one; if our past experience were different the effect upon the mind would likewise be entirely different. Yet the first, or possibly the only, thing of which we may be conscious is the train in motion, the sound as such may not be consciously noticed.

When a characteristic type of sensory impression is habitually associated with a certain nature of object as origin, then consciousness of that object tends to become an immediate result of such an impression, and, when this condition is reached, the interpretation of the impression becomes an integral part of the sensation; in other words, sensation merges into perception and ultimately the two become undifferentiable. The more accurate and the more capable of conveying unmistakable characteristics a particular sense may be, the more fully will it acquire this secondary character, and as vision is by far the most exact of our senses it has this adjunct most fully developed. Hence it is with strict accuracy that we say we see objects and not the light of objects, unless under conditions of very feeble illumination, or where from any other cause objective interpretation is difficult or impossible. Hearing is much less comprehensively informative, and the perception to which it gives rise is chiefly one of an action, combined, as a rule, with the actual sensation of sound. To some extent, therefore, we are entitled to say we hear a tramway car or an

aeroplane; but probably the immediate perception in most circumstances is that of some sort of motion, and unless the impression is a very characteristic one, it may be more nearly descriptive to say we hear the sounds themselves, further conception being for the most part due to inference. The distinction concerns the question: What is the state of consciousness aroused directly? are we aware of an object or of a sense impression which we interpret?

In the case of vision there is no doubt; under ordinary conditions we see objectively; our immediate consciousness is of the object with all its outward properties. Solid objects are no exception. Those attributes of the visual impression which are characteristic of objects of this class produce the visual feeling of the presence of a solid body, the quality of feeling, as I understand it, that constitutes stereoscopic vision.

It is customary to regard the dissimilarity of the fusible images upon the two retinae as a specific property which gives rise to this quality, but on the analogy of other kinds of sensation, any feature of the impression which is habitual, and which is sufficiently characteristic, ought to have the same effect, and I think it undoubtedly has.

Why should the specific function of binocular vision have been generally accepted for such special differentiation? There are, I believe, several reasons. The first is that it is the element which is most easy to abstract experimentally from our complete vision; we have only to shut one eye. Consequently we have a ready opportunity of observing that our vision suffers something by its loss, and we are apt to overlook that were we as easily able to abstract, let us say, the shadow effects from our impression, vision again would suffer. The second is, that experiments of the type of Hering's falling beads would seem to suggest that binocular vision is the all-important factor in stereoscopic judgment: this, however, is an entirely illogical deduction to make from them. They do not compare binocular vision with other distance guides, but with a state of almost complete absence of all guides. Another reason is, that one of the weaknesses of the function of binocular vision—its elasticity—allows it to act in the viewing of stereoscopic photographs through instruments which, being incorrectly constructed, place the other and more stable factors in stereoscopic vision into circumstances which do not appeal to them as habitual, and they consequently cease to contribute to it; in fact, to some extent, they oppose it. Our very elastic binocular vision is the only one of our major stereoscopic factors which is acting with full effectiveness in the stereoscopes we commonly use, and therefore its introduction or exclusion is, in these circumstances, the cardinal factor, but the circumstances are not normal. Finally, there is the influence of

stereoscopic lustre, the consideration of which I must postpone to a later stage.

I shall speak of only two of the many factors in stereoscopic vision; first, binocular vision, because of the peculiar importance which is customarily attributed to it; and, second, the sense of perspective, because I regard it as the greatest of all the factors, and because it will serve well for purposes of comparison. It is necessary, however, to consider, first, certain points regarding the sense of form, and the power of selective suppression of retinal images.

The sense of form is often spoken of as synonymous with, or at any rate as being measurable by, the acuteness of vision. Some observers maintain, however, that the sense of form is wholly distinct from the acuteness of vision, and that the recognition of the shapes of objects is a specific sense function. This is an important distinction, although it would seem doubtful if what we ordinarily estimate is not the same sense as applied to minimal sizes. The term "form sense" is, in any case, a somewhat arbitrary one, as this function is not of an elementary nature; as well as psychological factors, it involves several sense factors which may be grouped under the term, sense of relative direction, or, relative directional projection.

The acuteness of vision is concerned with the minimal appreciable separation of image points, but it is obvious that there is another factor which takes account of the degree of this separation. They are without doubt functions of the same sense. The relationship of the two functions might be compared to that between the light minimum and the light difference, although the analogy is an imperfect one. As in the case of the light sense, the increment necessary to make an appreciable "difference" is greater than the interval between zero and the "minimum." The differential factor is less exact in another respect; it is subject to modification owing to suggestion, as is exemplified in many familiar illusions: it is also subject to variation of psychical interpretation on definite geometrical principles quite apart from illusion.

This sense tells us the size and plane of the angle which the line of vision associated with any particular position on the retina makes with the line of central vision, and also the angular relationship of any two or more of such eccentric lines of vision. I use the term "relative" directional projection as distinguished from "absolute" directional projection, which is a much less accurate function involving other factors which in effect take account of the position of the eyes. The chief of these is the relationship of the foreshortening of retinal images to our conception of the form of the objects that give rise to them; during alteration of fixation the muscle sense has an importance also, but as a static factor it appears to have little value.

A definite explanation is available for the development of this function as a sense integer through experience, from the more primitive power of discriminating the values of the separation of stimulated retinal points. In uniocular vision an object whose image falls at any particular point on the retina will always be found in the same direction relatively to the eye, irrespective of distance. It is true that uniocular vision is not our customary vision, but in the matter of relative directional projection it does not differ from binocular vision. I shall refer to this subject later.

The power of suppressing the image of one retina is familiar, but we can under the influence of sufficiently compelling circumstances, and to some extent at will, suppress parts of the image of each retina, so that our conscious impression is of a composite view made up in part of the image of one eye, and in part of that of the other. Thus, if our two retinal images do not fit each other satisfactorily it is possible to cut off the bits that project or overlap. Only in comparatively few circumstances do we utilize the whole of both retinal images. For the moment I shall speak only of the possibility of this suppression, and later shall refer to its frequent occurrence.

FIG. 1.

On the original card the columns were set with the 6.5 cm. distance between centres. The figure as reproduced should be viewed at the reading distance with a pair of ordinary + 3.5 D. sph. lenses. Some mixing of figures may be seen, but with concentration it is possible to exclude any figure except the 4 and the 7.

I have marked a series of figures in two vertical rows on the card shown. They are arranged in such a manner that the rows will be superposed when seen through the stereoscope. Certain of the figures will be suppressed, and we shall see only one row composed partly of those on the right, and partly of those on the left. To some extent this may be due to false relative projection, that is to illusion of form, but a detailed study of the figures will show that this is not the whole explanation. From the two groups I see most readily the numbers 3, 4, 6, 7 and 8, but can choose either figure at any level. The 5 and 6 are so shaped that the complete ring of the 6 will fall on the open ring of the 5. If our eyes are fairly well matched we shall be able to see either the 5 or 6,

and after some study of the 5 it is possible to see it with either an open or a closed ring at will. When the ring opens it does not do so by bending away of the line which closes it, but by fading. We can actually observe the suppression occurring. Meanwhile the 4 and the 7 as well as one figure at each other level are fully visible, showing that parts of both retinae are in use.

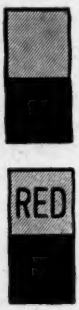

Fig. 2.

Fig. 3.

Another way of illustrating selective suppression is by means of colours, and that peculiar fluctuation of visual attention known as retinal rivalry. On a card I have drawn two rectangular figures each coloured one half red and one half blue, and have arranged them so that in the stereoscope the right red will be superposed on the left blue and vice versa. Each space may be filled in with red, blue, or transitorily by some people with purple. By an effort of attention we may be able to choose which colour will be seen in either space. If we see two blues or two reds it is obvious that as regards one colour we suppress an area from each retinal image.

A second card is similar except that the name of the colour is written in black letters across each red square. It is now much more difficult to see the blue squares. The sharp contrast of the black letters on the bright red ground fixes the attention, and the images with lesser contrast are not readily seen. This shows how easily the more prominent of two incongruous images may exclude its rival.

I shall point out later that owing to one or other image being favoured by the incident of the relationships of contour, such suppressions are constantly occurring in our binocular view of miscellaneous objects.

In light of these observations I think we can understand more fully the phenomena of stereoscopic vision.

There are two chief theories of binocular vision representing entirely different principles: the theory of corresponding points and

that of projection. Both are defective, for both involve serious inconsistencies. The former has obtained more ready acceptance than the latter, probably because it comes nearer to giving an explanation on purely physiological grounds. The theory of projection on the other hand has not been sufficiently developed, and it has in recent times fallen very greatly out of consideration, presumably on account of its seeming incompatibility with a median centre of perception. With appropriate expansion, however, it can be so formulated as to be entirely consistent with the facts, and to afford a complete explanation of them.

The classical theory of stereoscopic vision is elaborate and beset with difficulties. When we bring it to bear on the relationships of objects other than distant ones, it becomes necessary to assume that comparisons are made in reference to cylindrical or toric surfaces erected in front of us; surfaces of which nothing in our experience would ever lead us to become aware. This involves the further assumption that in the ordinary use of the eyes we can estimate relative values of retinal disparation, that is in terms of their effect, without being able to appreciate when zero is reached. Such a combination is hardly credible.

It is of course obvious that there are corresponding points, and that there are horopters geometrically, in fact they can be discovered by careful physiological experiment; but it does not follow that they have a physiological significance. It has been suggested that each pair of corresponding points is linked up to the same nerve cell, but this view has been shown by McDougall* to be untenable. Hering went so far as to postulate that definite amounts of disparation of stimulus have fixed depth values.

If such a correspondence and fixed signification were native characters of our visuo-psychic mechanism, it would be contrary to the analogy of all other sense interpretations: but apart from that it can readily be shown that such a view does not help us. During the course of growth in childhood, the displacement ratios would be deranged as the interocular distance gradually increased. The growth of the eyeballs is not a compensatory factor geometrically, and in any case it is approximately completed much earlier than the growth in breadth of the face. A re-adjustment of the meanings of given amounts of disparation would be necessary, thus throwing us back again on the criterion of experience.

If retinal points are not associated congenitally there would appear to be no means of their becoming so in a direct sense by acquirement, for images of individual points fall on corresponding positions only in distant vision, or if the source should chance to lie on the horopter. We much more often use the eyes for

* W. McDougall, "On the Relations between Corresponding Points of the two Retinae," *Brain*, Vol. XXXIII, 1911.

comparatively near objects than for distant ones, however, and associated image points, therefore, commonly fall at positions that do not correspond; positions that are continually varying with our changing fixation. The two points of central vision are the only points which by experience have a direct means of becoming associated. It follows that other points will have an indirect correspondence when their lines of vision bear to their respective lines of central vision a relationship indicating similar projection. This I believe to be the limit of the association of so-called corresponding points; it explains the possibility of discovering them by experiment, and it further explains the great difficulty that is found in doing so. No other view so fully accounts for the fact that many squinting eyes develop a new system of corresponding points, a condition which, if this view is right, is but a geometrical concomitant of the acquirement of a new centre of fixation.

Not only does the direct physiological association of corresponding retinal points appear to be improbable, but its assumption is unnecessary.

We have a sense of directional projection both relative and absolute developed in connection with each eye, and the point of crossing of the two lines of vision associated with any point in space will fix its position in three dimensions, the intersection being the only point common to both axes. The fixation of vision on any particular point by correlating the absolute projection as determinable from each eye, will permit of a very accurate estimation of the relative position of any two points, for this can then be determined in a similar manner by the much more exact sense of relative projection alone.

As the directional projection of an image is an act of the projection sense of the eyes individually, so the distance projection is an act of the same sense of the two eyes together.

That is one aspect of the binocular factor, and it explains the very accurate relative location of individual points without the pre-supposition of any hypotheses except one, namely, that the function of directional projection continues to be exercised in binocular vision through each eye individually, unaltered in a physiological sense. Of this I shall speak later.

When instead of a point an object with magnitude and form is considered, there arises in addition the question of the signification of dissimilar form by the images on the two retinae. Were we to fuse such images in the sense of superposing them, it would be necessary to establish a condition of error of relative projection in one or both eyes, but if we fit one image into the other, not on to it, they are a perfect fit, without modification. If we look at a sphere with one eye and imagine a line drawn around it at the visible periphery as seen from that position, and if then we look

with the other eye and mark the periphery from the second position, we have the potential silhouettes of our binocular image. As our consciousness is of a solid body those silhouettes will fit on to our conscious image without modification of form. The whole surface seen will include the large area common to both eyes, and the strip particular to each.* The same principle is applicable to all solid forms. The effect of this binocular view is to give us a certain amount of additional evidence in the construction of our solid image, but not to make the visual mechanism react in a modified manner in regard to each retinal image. This extra evidence is not on the peripheries only, we get two complete perspectives, each perfectly fitting the other. These perspectives differ considerably in the nearer parts, but gradually merge into equality as distance increases. If we look at a stereoscopic pair of photographs with straight lines represented running towards us, as for example the tramway lines on a street, it will be seen that the directions on the two pictures are quite different, yet they fit with absolute comfort when seen through the stereoscope: there is no delay, discomfort, or feeling of unrest, such as is experienced where one image interpretation is really accommodated to the other. This latter condition can be observed through the stereoscope on cards with dissimilar figures, where the dissimilarity is not sufficiently great to cause actual suppression of one image; a 1 and a 2 if suitably formed will serve the purpose.

The extreme case of differential images would be represented if we were able to converge each eye 45° and focus accordingly. Then we could look at the front and the side of an object simultaneously, the face and the edge of a coin for example. The mental images would still fit into each other perfectly, but of course they could not be made to coincide with each other. The individuality of each retinal impression exercises an influence on the perception, but there is no intermediate sensation. Ordinarily we are not conscious of retinal images however like or unlike they be. We are conscious of nothing within us, only of an object without.

Our knowledge of retinal images tends to make us exaggerate the importance of a particular sub-station on what is merely a system of communication. The fact that the images are of this shape or that at the place where light radiation transfers the message to nerve conduction, gives no indication, ipso facto, of our ultimate perception, either as to its superficial form or its solidity.

As the perception of form is a function of the sense of relative projection, we have in this fitting of the images another call on the

* Subject theoretically to marginal suppression or transparency; *vide infra* the impossibility of seeing around objects. The effect in the case of a sphere is under ordinary circumstances, however, too slight to be appreciable.

hypothesis with regard to binocular projection of points, that each eye maintains unaltered the influence of its projection sense individually in binocular vision.

Although for descriptive purposes I have treated of the binocular sense in two sections, the separation is artificial. Acting as part of the fitting of one image into the other, we have a correct projection of each image point to its true place on the solid image. Over part of the image, however, the distinction which I have drawn is essential. The part that is not common to the two images can receive no binocular aid in the projection of points. This part is represented by the two crescents on the sides of the sphere, and in the case of rectangular convergence there might be no common image points except along one line, according to the shape of the object.

If the various points on the surface of a solid body were projected in accordance with a principle which demanded as a price for the projection in depth a compromise of the interpretation of the retinal images individually, then we should of necessity get distortion.

That part of the object seen through both eyes would have a perspective truthful for a median position of observation: the parts seen through each eye individually would have a perspective truthful for a lateral position of observation. There would be parts of two different perspectives received through each retina. Those parts of the retinal images common to both would be given a modified interpretation, and the remainder would be interpreted as in uniocular vision. The sense of relative direction would thus be falsified. It may be said that no such distortion is necessary, for we can, and commonly do, see from a median position even with one eye. I shall show, however, that when we do this we get false projection.

This involves a consideration of the axis of vision, a subject regarding which there is a great deal of confusion of ideas.

It is unquestionable that customarily we see from the middle of the inter-ocular space, but this does not require any physiological modification of the effect of the retinal images. We see from one centre which we may place where we please; it is merely the point where we conceive ourselves to be for the purpose of establishing our relationship to the objects seen. Consistency with the distribution and extent of the surface areas of each object available to vision, determines that unless by conscious effort to do otherwise we shall ordinarily place our point of view or centre of visual consciousness midway between the eyes in binocular vision. The line joining the line of fixation to the middle of the inter-ocular space may therefore be described as the axis of perceptive vision. The effect of the eccentric position of the eyes upon the shape of

the retinal images is psychically self-compensatory. If I look at the doorway in the wall on my left my retinal images are far from rectangular, yet without any mental analysis or reconstruction my perception is of a rectangular doorway. The only respects in which the view differs from one seen from directly opposite is in its direction in relation to myself and in the hiding of some of the depressed surfaces. There is no difficulty, in conception at least, in projecting my point of view to a position opposite the doorway and thus seeing from in front. That gives a conceptual axis of vision, an axis of which by mental effort we can definitely make use, but which has no practical importance except for descriptive purposes. If I had another eye at an equal distance beyond the door, the deficiencies of the hidden parts would be filled in; the placing of the point of view at the mid position would be habitual, and thus that position would be through custom the centre of perceptive consciousness, and the axis of conceptual vision would now be the axis of perceptive vision.

We have an optical or physiological axis of vision for each eye, the line of vision with which we are familiar. There is no optical axis of binocular vision.

The theory of a Cyclopean eye, based on that of corresponding points, provided a symbolic central optical axis; but it is strictly applicable only to duplicated images; the angles which the lines of true projection make with it do not bear a constant relationship to the mean of the angles formed with the two optic axes.

In uniocular vision the perceptive axis is variable; in very deliberate uniocular vision, as in shooting, this axis coincides with the optical axis; but when the use of one eye is more casual the perceptive axis is usually in the same line as that of binocular vision, yet there is a great difference in the means by which this is brought about in the two cases. In this median type of uniocular vision the optical axis is merely swung round, in other words, the psychic interpretation of the grouping of angular relationships to the axis remains true to the optical conditions, but as the position of the axis is wrongly interpreted the psychic projection is false. When as in shooting, however, the perceptive and optical axes coincide, the whole system of psychic projection is truthful.

The two conditions are shown in the accompanying figure. If C A is the optical axis and F A the perceptive axis, that is if we falsely believe C A to be in the position of F A, as we do in casual uniocular vision, then the fixation point A will be correctly projected, but the point B will be projected to G: the relationship will be correct but the whole view will have been rotated around the point A.

If on the other hand C is felt to be the point of observation, then CA is the perceptive axis, and both A and B will be correctly

projected. It is possible now to make FA a conceptual axis, and to think of B as lying between A and an imagined point of view at F: this is the part played by each eye in normal binocular vision. The coincident conceptual axes of the two systems of uniocular vision, that is right and left, become the common perceptive axis of binocular vision. In binocular vision with duplicated images the interpretation is made as in the median type of uniocular vision, with projection of the point B to G by the right eye, and to a corresponding point on the right of FA by the left eye.

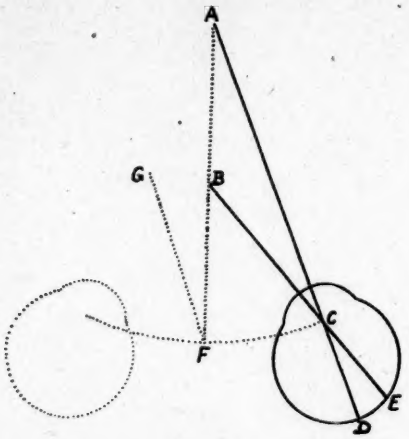

FIG. 4.

Alterations in the adoption of the various visual axes necessarily have an important bearing on disturbances of orientation in cerebral lesions.

In normal binocular vision the correlation of the two eyes, that is of the two paths of visual information, is made in relationship to the one invariably corresponding line of each, the lines of foveal vision, the optical or physiological visual axes; and for each eye the system of relative directional projection remains intact; that is, although the median line becomes the perceptive axis, the positions of the physiological axes are not misinterpreted. We can observe this in the use of a stereoscope which has no dividing screen between the two eyes: three images may be seen, the middle one being binocular, while the lateral uniocular images bear the same relationship to it that they do consecutively if first one eye and then the other be used separately. It will be pointed out later that although the correlation of the two eyes has reference to the foveal visual lines, it is not necessarily achieved by means of them.

Bilateral vision without physiological fusion and yet with perceptive singleness may be compared to the perceptions arising from the stereognostic senses concerned in the handling of a solid body. If a book is grasped between the two hands we become aware of certain facts regarding the book, its contour, its surface finishing, its unity. The information is gathered from the sides, but the object is perceived to be in front of us. In addition to the perception of the object we also become aware of the more primitive subjective sense feelings, that is of the ordinary sensations considered physiologically. These are referable to the two hands and arms individually; they are essentially and obviously duplicate.

Attention to these sensations would cause duplication of our perception of the object were it not that we have a distinct knowledge from which side each sensation comes, and are thus enabled to correlate them and perceive one book. In the case of the eyes, however, we are unable consciously to distinguish on which retina an image falls, although this differentiation, achieved unconsciously, has an essential influence in binocular vision. I shall show that we may explain on the ground of these relationships to consciousness the fact that under certain conditions we get duplication of visual images.

This phenomenon of double images is very important. It gives another evidence of the maintaining of the correct projection relatively to each eye separately during binocular vision, the assumption of which I have said was necessary to the projection theory. It is also a critical question in relation to the consistency of either theory.

Under what conditions do we see double images? If we fixate a point and any other object comes into close proximity to one of the lines of vision, either between us and the fixation point, or beyond the latter, then one of two things will happen: either we may get duplication or we may receive the impression through one eye only and suppress the other image. We cannot obtain fusion, that is unification without suppression, if one image occupies the fovea and the other is not central; nor can we make images that lie heteronomously off the fovea fuse over it. If a minute ink spot on a piece of paper be observed binocularly, and if a fine needle point be made to approach the lines of vision in a plane about a quarter of an inch from the paper, and in a direction transverse to the interocular line, the foregoing facts can be observed. Sometimes fusion of the two images of the needle point may appear to have been achieved, but closure of one eye will reveal from the parallactic displacement that what has happened is the suppression of one image.

In looking immediately past the vertical margin of any object on to a more distant background, provided the latter bears sufficiently distinctive markings to enable us to observe how much of it we do

see, it will always be found that one image of the margin is suppressed and that the amount of background seen binocularly is the same as that visible to the more favourably situated eye. If this eye be now closed the suppressed image becomes available, and the nearer object appears to spring across towards the side of the closed eye. In such circumstances the total of facts available to vision is not consistent with a single point of observation. Given the requisite conditions these phenomena are independent of attention, that is they remain unaltered down to the lowest degrees of attention compatible with perception of the objects concerned.

Under conditions of attention, which of course is a relative term, fusion is not obtainable in the vicinity of the macula or in the position occupied by the images of objects lying between the lines of vision. For a variable distance beyond the macula, a distance which may be much increased by augmented concentration, it is also unobtainable. Another effect of specific effort is that we may be able to retain both images where otherwise one would dominate to the complete exclusion of the other.

Now, according to the theory of corresponding retinal points, all images of objects ought to be seen double if their disparation exceeds certain very narrow limits of fusion. In ordinary circumstances we see no duplicated images, however, and throughout most of the binocular field our perception does not suffer from the parallactic displacement which unification by suppression of one image from a pair of duplicates always entails.

In support of the theory of corresponding retinal points it is said that the images are double, but that they are not seen to be so unless specifically attended to. The alternative, and I think the true explanation, is that they are not double until the act of attention makes them so. It is plain that we are quite capable of appreciating duplication in the periphery of the field without special attention, for if we produce even a small amount of diplopia with prisms duplication is widespread.

According to the theory of projection, single binocular vision is normal, and duplication under conditions of attention, whether this be due to prominence of an object in the central field or to voluntary effort, is readily explicable as follows: In order to adapt the laterally placed physiological visual axes to perceptive vision in the middle line, a psychical adjustment of the interpretation of the visual angles is necessary. Under normal conditions of a purely objective perception this is easily accomplished, just as it is easy, in fact almost unavoidable apart from special training, to perceive the rectangular form of a doorway that is not directly opposite the observer. When, however, the macular area is encroached on, or when concentration of attention is exercised, a relatively greater part is played by the element of pure sensation, in the same

manner as attention makes us more definitely aware of the subjective part of the sensation in the handling of a book or other object. This reaches a degree such that the sensational angular relationships to the optical axes, that is the physiological visual angles, become accepted as the basis of perception. But as the axis of perceptive vision is in the line joining the middle of the interocular space to the fixation point, these angles are interpreted in relation to this line. Double images are therefore seen in directions making with the middle line angles equal to those which the optical lines of vision of the object and of the fixation point make with each other (cf. Fig. 3). The distance of these falsely projected images is optically indeterminate, and psychically variable. Preconception and the relationship to other objects seen singly tend to place them at the distance of the object they represent; while, in

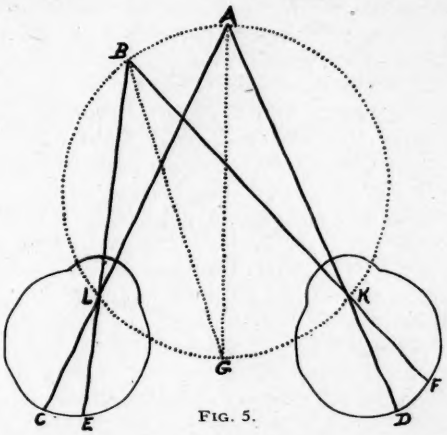

FIG. 5.

so far as they can be dissociated from these factors, the act of attention tends to carry them towards the plane of fixation. It may be asked, why do we never see in duplicate on corresponding points? If such points have no physiological significance, why should they be an exception? The reason is that from the accident of their geometrical position the double images which they would produce happen to be projected along the same line.

If E and F (Fig. 5) are corresponding points, images of the point B on the horopter, then the angle AKB will equal the angle ALB; that angle is the amount to which KB and LB lie to the left of KA and LA respectively; therefore both images will fall to the left of GA to the extent of that angle, that is they will both fall along the line GB.

(*To be concluded.*)

ANNOTATIONS

The Ophthalmologists and the General Medical Council

In a short annotation we referred to this subject in our last issue, and we make no apology for discussing it again. The more the decision of the Council is examined, the more unsatisfactory does it seem. The impression is unavoidable that the Council has entirely misunderstood the situation, and especially its importance. The "light and airy" manner with which the subject was dealt with would imply that the Council regarded the recommendations of the ophthalmologists as an attempt to enforce their convictions by an act of fussy and inexcusable officiousness. Nothing, however, was further from this purpose. The recommendations were based upon an explicit realization of the disability to which the public were exposed by the scanty teaching of ophthalmology at the present day. This neglect, the Council was informed, could only be avoided by the introduction of a statutory examinational test, conducted of necessity by ophthalmic surgeons. Having regard to the importance of the issue, so far as the public were concerned, the reform suggested was rational and only in accord with a progressive line of policy which the times demand. Despite this, however, the Council has decided to assume a non possumus attitude. Furthermore, it is regrettable that the reasons upon which the decision was based were held from the ophthalmologists. There was surely due to the ophthalmologists a considered explanation of the grounds upon which their important recommendations were rejected; as there is no eye specialist amongst their number, courtesy alone demanded this, even from so august a body as the General Medical Council. The recommendations may have been deemed by the Council to be beyond its power to enforce, without a special clause to this effect in the Medical Acts. If that were so, why has the fact not been openly stated? The Council has affirmed that its chief reason for pursuing a strenuous policy to improve and strengthen the Dental Acts, was the vigorous movement which was being taken in this direction by the dental profession in allied countries. It may be pointed out that the same policy of progress is being carried out in regard to ophthalmology, as a perusal of the medical journals, for example of America, will show; that fact in itself emphasizes the importance of the recommendations of the Council of the British Ophthalmologists which the Medical Educational Authority of this country has declined to accept. This subject is discussed in a leading article in the *Medical Press*, July 2, in which the conclusion is arrived at that "impartial critics can scarcely admit that the position assumed by the General Medical Council redounds to the Council's credit. Modern times demand, not parochial restrictions, but advancement in matters educational." And to this

we may add that where the issues to the public are so important as are those which the ophthalmologists have rightly claimed them to be, it is the duty of the Council to concede the introduction of a reform for which such urgent necessity has been shown.

The Early Treatment of Ophthalmia Neonatorum

In our last issue we noted that a practitioner was fined for failing to notify a case of ophthalmia neonatorum. The object of notification is not to prevent the spread of the disease, but to see that the child receives prompt and proper curative treatment, which as a rule cannot be carried out in the patient's own home.

In London, and in several of the larger towns, following the example of Manchester, special hospital accommodation is provided which will receive both mother and baby for treatment. In the metropolis, under the auspices of the Metropolitan Asylums Board, St. Margaret's Hospital, Leighton Road, Kentish Town, was opened last September, and it is proposed at a later date to open another hospital on the south side of the river. Ambulances are provided to remove both mother and baby to the hospital immediately on receipt of a message either by telephone or other means of communication with the Metropolitan Asylums Board.

For these hospitals to serve the purpose for which they are intended, namely, the prevention of blindness by corneal ulceration, which usually starts during the first few days of the disease, it is obvious that the cases must be admitted at the earliest possible moment. We are informed that during the first few months in which St. Margaret's Hospital was opened, the average date of admission was three weeks, which is obviously too late to prevent corneal ulceration. Latterly, the conditions have improved, partly on account of the more active representation of the Medical Officers of Health, and partly owing to the fact that the cases are now admitted on the request of the Midwives of the London County Council without losing time in obtaining a certificate from a Medical Officer. In spite of this there are still a number of children admitted to this hospital with severe corneal ulceration in a late stage of the disease. Many of these come from hospitals and general practitioners, both of which, although they have been informed of the existence of special hospitals, have forgotten their existence until too late to save the eyesight of the child. We cannot urge too strongly the necessity of the efficient and early treatment of the disease, and that practitioners and resident medical officers should from time to time be reminded of the existence of special hospitals for its treatment.

Railwaymen's Sight

In February, 1918, we called attention to the urgency of the question of fixing some definite standard of vision for engine drivers in this country. We pointed out the chaotic condition of the present railway regulations and some of the difficulties that would require to be faced. Similar difficulties had to be faced and solved in dealing with the visual requirements of the Mercantile Marine. In the early part of this year the Council of British Ophthalmologists appointed a committee to consider the question from the scientific standpoint, but although the project was regarded favourably by the Board of Trade, the opposition of the Governing body of the railways held up the work of the committee. The attention of the public has now been awakened to the urgency of the question by the strike on the North-Eastern Railway, and we understand that a national standard of eyesight for railway men has been promised. It is to be hoped, not only for the sake of the railway men themselves, but for the safety of the general public, that a genuine attempt will be made to arrive at some scientific standardization of the various visual factors which enable a man to be an efficient and safe driver. The following correspondence has recently appeared in THE TIMES:

EYESIGHT TESTS.

To the Editor of *The Times*.

SIR,—The strike on the North-Eastern Railway brings to the surface a grievance which has been agitating railwaymen for some considerable time. On the face of it, it seems obvious that eyesight tests are necessary, since the safety of the travelling public depends upon the good vision of engine-drivers and others. Yet it should not be too hurriedly concluded that the grievance is wholly illusory. It probably depends chiefly upon the unsatisfactory nature of the examinations, which do not enlist the confidence of the men. A similar state of affairs existed some years ago in the mercantile marine. In this case a Departmental Committee was set up by the Board of Trade, their recommendations were adopted, and eventually both the shipping companies and the men's federation were so impressed with the fairness and adequacy of the tests that only sporadic cases of dissatisfaction now occur. So successful a precedent should influence the Board of Trade in dealing with the railway problem, which had, indeed, already been brought to their notice by the Council of British Ophthalmologists.

I am, Sir, yours faithfully,

J. HERBERT PARSONS.

54, QUEEN ANNE STREET, CAVENDISH SQUARE, W.1., *July* 17.

RAILWAYMEN'S SIGHT.

To the Editor of *The Times*.

SIR,—In the early part of this year the Council of British Ophthalmologists appointed a committee to consider the standards of vision for men engaged in railway transport. There has been no scientific investigation of the problem in this country. The efficiency of the methods employed in different railways varies greatly, and they are not controlled by the Board of Trade. The purpose of the proposed committee was purely scientific, but for various reasons its work had to be suspended. Recent events have shown the urgency of the question, and the Council of British Ophthalmologists are quite ready at any time to give the expert aid that can only be given by ophthalmic surgeons.

Yours faithfully,

LESLIE PATON,
Hon. Secretary to the Council of British Ophthalmologists.

29, HARLEY STREET, W.1, *July* 18.

RAILWAYMEN'S SIGHT.

THE TEST IN USE.

To the Editor of *The Times*.

SIR,—In your issue of July 18 Mr. Herbert Parsons ventures the opinion that the present trouble on the North Eastern Railway "probably depends chiefly upon the unsatisfactory nature" of the company's eyesight examinations, "which do not enlist the confidence of the men." I do not gather that Mr. Parsons has taken the trouble to make inquiries as to the nature of the tests on the North Eastern Railway, or even as to whether it is a fact that the systems adopted are disapproved by the men, but your readers may like to know that the test which has given rise to the present trouble is one which was instituted at the request of the men themselves, viz., the test of stating the position of signals on a disused portion of railway at varying distances. This test is only made use of in the case of men who have failed to pass the ordinary type-reading test, and was adopted as a supplementary test to meet the view held by a number of railwaymen that an out-of-doors test is fairer and more reliable, in the case of men whose duties lie out of doors, than one made in a room.

I am, Sir, yours faithfully,

A. KAYE BUTTERWORTH.

NEWCASTLE-ON-TYNE.

EYESIGHT TESTS.

To the Editor of *The Times*.

SIR,—Sir A. Kaye Butterworth forgets the fact that people are not always satisfied when they get what they ask for. The demand for a so-called "Practical Test" is no new one. "Such a test, carried out in normal atmospheric conditions, would probably fail altogether to detect candidates whose ability to distinguish between red, green, and white lights under less favourable conditions of weather is open to grave doubt."

"The contention that persons who fail to pass an indoor test of colour vision may nevertheless be relied upon to distinguish accurately the colours of the lights which they meet with in the ordinary course of their duties at sea has been met by the results of the experiments conducted by the Committee at Shoeburyness." These are two of the comments on this point by the Departmental Committee of the Board of Trade on Sight Tests (Cd. 6256, p. 13, 1912). The Committee made exhaustive experiments at Shoeburyness, and, indeed, it was due to a demonstration carried out there in the presence of Mr. John Burns, then President of the Board of Trade, that both masters and men were convinced of the efficacy of the Board of Trade lantern. As, however, a national eyesight test has been agreed to, the interests of both the travelling public and the men will be safeguarded, and further comment is unnecessary.

I am, Sir, yours faithfully,

J. HERBERT PARSONS.

54, QUEEN ANNE STREET, W.1, *July* 21.

THE OXFORD OPHTHALMOLOGICAL CONGRESS, 1919

THE Tenth Annual Meeting of the Oxford Ophthalmological Congress was held on July 10th and 11th last in beautiful weather. Members were lodged in Keble College and the scientific proceedings took place in the Department of Human Anatomy of the University (kindly lent for the purpose by Professor Arthur Thomson), where technical and commercial museums were also arranged. The programme was opened on July 10th by an address of welcome by the Master. Major Walter H. Kiep, R.A.M.C., read a paper on the ocular complications of dysentery, which was followed by a good discussion on the subject. Major Edgar H. Smith, R.A.M.C., read a communication dealing with "Quinine Amaurosis," well discussed by the members present. Dr. William McLean, of New York, described his further experimental studies in intra-ocular pressure and tonometry, and exhibited his latest model tonometer. We hope to publish his paper in these columns shortly. The event of the meeting was a discussion on "Preventive Ophthalmology," introduced by Colonel J. Herbert Parsons, C.B.E., consulting ophthalmic surgeon to the Forces. Colonel Parsons pointed out that the scope of his subject dealt with the prevention of damage (*a*) to the individual, and (*b*) to others. (*a*) included many subjects, such as prevention of damage to the eyes from accidents, defective illumination, deleterious rays, and organisms, and the prevention of damage to health from headache, accident, fatigue, etc. (*b*) included regulations for the prevention of the transference of contagious disease and rules for Navy, Army, Air Force, Mercantile Marine, Railways, Motor Industry, Cinemas, and so forth. The problems of preventive ophthalmology constituted a question of collective

action, and were of particular value at the moment, when projects of reconstruction were to the fore. In connection with the prevention of accidents to the eyes in factories, there is urgent need of a scale of awards for compensation founded upon scientific principles. The formulation of regulations for the Public Services demanded (1) a widening of the basis of education of ophthalmologists; (2) co-operation between ophthalmologists and other experts; and (3) improvement in the methods of examination of candidates and the selection of examiners. A good discussion followed the address, after which the Doyne Memorial Medal was presented to Colonel Parsons by the Deputy Master, Mr. Philip H. Adams. In the afternoon members and their friends were entertained to tea in the gardens of Trinity College by Mr. D. N. Nagel, M.A., and Miss Nagel. In the evening the annual dinner of the Congress was held in the hall of Keble College, some seventy members and visitors being present. The toast list was commendably brief.

After dinner the annual general meeting of the Congress was held in the junior common room at Keble College. Among other things it was determined, on the motion of Mr. J. B. Story, to make representations to the General Medical Council in support of those recently preferred to that body by the Council of British Ophthalmologists concerning the instruction and examination of medical students in eye work. Readers of this Journal are aware that the recommendations in question have been rejected by the General Medical Council.

On July 11th the proceedings began with a paper by Dr. S. Lewis Ziegler, of Philadelphia, on "The Problem of the Artificial Pupil; Knife-Needle versus Scissors." Dr. P. Baillart, of Paris, followed with a communication dealing with his dynamometer for determining the blood pressure in the branches of the central retinal artery. Mr. A. F. MacCallan, O.B.E. (Cairo), read a paper on the "Seasonal Variations of Acute Conjunctivitis in Egypt." Colonel A. H. Tubby, C.B., entered a suggestive plea for investigation as to any possible connection between skeletal asymmetry, on the one hand, and defects of the eye, on the other. A pathetic feature followed when a discussion upon employment for the blind was introduced by three blind speakers, namely, Mrs. Adolphus Duncombe, Captain Peirson Webber, and Captain Towse, V.C. The subject was discussed most sympathetically by the meeting, and it is to be hoped that some useful action will be undertaken by the Congress in connection therewith. In the afternoon the Ashhurst War Hospital, at Littlemore, near Oxford, was thrown open to members by Lieut.-Col. T. S. Good, R.A.M.C.

ABSTRACTS

I.—CONGENITAL WORD-BLINDNESS

Schröck, Rudolf (Rostock).—On congenital word-blindness. (Ueber kongenitale Wörterblindheit.) *Klin. Monatsbl. f. Augenheilk.*, February-March, 1915.

Schröck prefaces a description of three cases of congenital word-blindness in young subjects with an account of the history of the condition. He rightly assigns the description of the first cases to James Kerr (Howard Prize Essay of the Royal Statistical Society, June, 1896, and *Lancet*, May 19, 1900, p. 1,446), and alludes to other cases by Morgan (1896), Hinshelwood, Nettleship, Wernicke (1903), Lechner (1903), Stephenson (1904), Bruner (1905), Thomas (1905), Schapringer, Claiborne (1906), Variot and Lecompte (1906), Fisher (1915), and others. Until 1908 in Germany the condition had not received the attention it deserved. Peters then drew attention to congenital word-blindness.

In abstract, Schröck's cases are as follows:

(1) Girl, eight years, well developed physically. Good at mental arithmetic. Poor memory. Knew single letters of the alphabet, but was unable to combine them into words. She wrote badly to dictation, and after the lapse of some time was not able to read what she had written. A brother showed some signs of word-blindness, although in other respects normal.

(2) A girl, 12 years, with good memory, but slow at figures. She did not always understand what she had written,

(3) Girl, 13 years, with good family history. She was normal in all mental respects except for arithmetic and dictation.

Two further cases in children are mentioned by the author, but neither is typical.

S. S.

II.—BINOCULAR VISION

Landolt, Marc. (Paris) — Observations on binocular vision. (Considérations organologiques sur la vision binoculaire.) *Arch. d'Ophtal.*, November-December, 1917.

Landolt begins his remarks by a review of the conditions, anatomical and physiological, which contribute to the perfected development of the visual apparatus in man, with reference especially to the function of binocular vision, and compares them with the

characteristics of the organs of vision in the lower vertebrates. He devotes special attention to the optic and orbital axes, which vary in the ascending scale from a very wide divergence, as in birds and reptiles, to an approach to parallelism in the highest vertebrates.

In the evolution of binocular vision "we find that the orbital and optic axes tend more and more towards parallelism, *i.e.*, they tend to coincide with the direction of the rays upon which binocular vision depends."

Landolt's paper is one which cannot be dealt with satisfactorily in an abstract. His concluding remarks, however, contain a brief summary of his views.

The evolution (of binocular vision) presents two chief stages. In the first, the strictly lateral eyes are brought to an imperfect degree of collaboration in which a small and peripheral area of binocular vision is attained. Accomplished, perhaps transiently, by movement of the eyes, this condition becomes definitely established by an alteration in the direction of the orbits.

The second stage is characterised by the acquisition of central binocular vision. This results in more defined retinal images and a more extensive binocular field.

In this second period of evoluton, the direction of the orbits undergoes as much variation as the bony skeleton permits (there are some monkeys in which the orbits diverge less than in man); the remainder of the evolutionary process is accomplished by changes in the scleral envelope, either by an angular deviation of the anterior segment (as in the owl) or by a rotation of the globe, shown by the space which separates the optic papilla from the posterior pole of the eye (as in Primates).

As soon as central binocular vision has been acquired, the association of the two eyes in movement becomes consolidated; the superposing of the functional centres of the two retinae and the maintenance of this superposition leads to the correlation of the muscular apparatus, and a new function, that of convergence of the optic axes, appears, an indubitable proof of the existence of highly developed binocular vision.

J. B. LAWFORD.

III.—IRIDO-CYCLITIS ASSOCIATED WITH ANTITYPHOID INOCULATION

Prélat.—A case of bilateral irido-cyclitis during antityphoid inoculation. (Un cas d'iridocyclite bilatérale au cours de la vaccination antityphoïdique.) *Arch. d'Ophtal.*, November-December, 1917.

The writer has been well-advised in publishing notes of this case.

The man was sent to the Tenth Ophthalmological Centre of the French Army, labelled, "Iritis occurring three days after a second antityphoid injection; transient albuminuria followed the first injection." An interval of two weeks separated the two injections.

When he came under observation on January 24 he had acute bilateral irido-cyclitis with severe subjective symptoms. The conditions became aggravated during the next few days, and on February 5 there were visible in each iris numerous vascular nodules, mostly situated near the peripheral border; a fine precipitate covered the lower half of the posterior surface of each cornea.

The Wassermann reaction was strongly positive and a definite history of a primary syphilitic lesion seven months previously was forthcoming. The disease rapidly subsided under active anti-syphilitic treatment.

Prélat concludes his article with the following remarks:

Antityphoid inoculation in syphilitics free from disease of the anterior segment of the eye appears to be devoid of risk. If in such patients ocular lesions develop during the inoculation treatment, the latter should not be held responsible for the complication. On the other hand it is prudent, as advised by de Lapersonne, to abstain from antityphoid inoculation in syphilitic subjects who have had lesions of the uveal tract, which might be excited to recrudescence by the action of the vaccine.

In view of the medico-legal difficulties which might arise in these cases, ocular complications which may develop during a course of antityphoid inoculation should not be attributed to the treatment, except after a complete and accurate examination of the patient; such aetiology should be accepted only with great circumspection, and after a thorough sifting of all available evidence.

J. B. LAWFORD.

IV.—NEURO-EPITHELIOMA

(1) **Berrisford, Paul D. (St. Paul, Minn., U.S.A.)—Statistical notes on glioma retinae, with a report of forty-one cases.** *Roy. Lond. Ophthal. Hosp. Rep.*, Vol. XX, Part i, March, 1916.

(1) **Berrisford** carries on the work on glioma retinae, which has been done in the past by Messrs. Collins, Lawford, Marshall, and Owen. During the last 42 years the ratio of glioma retinae to other diseases at the Royal London Ophthalmic Hospital has been slightly more than 0·01 per cent. The 41 cases now under review support

the opinion that glioma retinae occurs more often in males than in females (males=22, females=17, sex not recorded in 2). The proportion of bilateral to unilateral cases was 1 to 7, which is below the usual figure. The tumour was observed at birth in 3 cases, within the first year in 9 cases, during the second year in 6 cases, during the third year in 3, during the fourth year in 4, during the fifth year in 3, and during the sixth year in 2. Nine cases out of the 41 may be considered as cured, three years having elapsed since enucleation. The importance of cutting the nerve far back is emphasized by the fact that in not one of the 9 recoveries, had the growth invaded the optic nerve as far as its cut end. In one of the cases the glioma occurred in a shrunken eye; previous literature contains only 20 such cases. There are only two previous instances in literature where a child once affected with glioma has grown up and has had children who developed the same disease; the present series adds a third case of the kind.

R. H. ELLIOT.

(2) **Ring, G. Oram (Philadelphia). — Recurrent neuro-epithelioma.** *Trans. Amer. Ophthal. Soc.*, Vol. XV (1917), p. 217.

(2) A child, aged 8 years, was seen in January, 1916, when the advice given to the parents to have one of the child's eyes removed on account of neuro-epithelioma was disregarded. The lens of the affected eye was dislocated in consequence of an injury. The iris was tremulous. The lower half of the retina was detached, and the irregular retinal elevation suggested a solid background. After the condition had lasted about eight months a violent contusion ruptured the affected eyeball, which was enucleated. Recurrence stated to have been noted in the orbit about one month after the operation. Patient seen for the first time by **Ring** towards the end of October, 1916, when a recurrent growth filled the orbit and projected from it to nearly half the size of the child's head. Its anterior surface was ulcerated and septic. The case was treated by William L. Clark by electro-thermic and other means, full details of which may be found in the original communication. This intervention was followed by much improvement, both local and general. But the child developed a spinal metastasis, followed by convulsions, unconsciousness, and death. No autopsy. Ring pleads for "a reasonable modification of the usually accepted belief that operation in recurrence is absolutely useless."

S. S.

V.—NODULAR OPACITY OF THE CORNEA

Uhthoff (Breslau).—A case of bilateral central punctate subepithelial keratitis, "nodular keratitis" of Groenouw, with anatomical findings. (Ein Fall von doppelseitiger zentraler, punktförmiger, subepithelialer Keratitis "Knotchenförmiger Keratitis" Groenouw mit anatomischem Befunde.)

Uhthoff's patient was a young man of 21 years who had been for long somewhat short-sighted. Beyond measles and an attack of pleurisy he had always been healthy. At 15, his sight began to be dim, and at that time nodular keratitis was diagnosed by Professor Groenouw who had recommended the scraping off of the superficial layers of the cornea.

Vision (corrected for myopia) was 6/12 in each eye. Numerous small, round, sometimes confluent, grey foci lay over the central area of each cornea beneath the epithelium. The eyes were free from inflammation. After 2½ years the condition was worse. A portion of the superficial layers of the cornea was shaved off and examined microscopically. The following changes were found: 1. Partial local thickenings of the epithelium projecting backwards through gaps in Bowman's membrane. The little nodules thus formed lay in pits in the superficial corneal layers. 2. Below the epithelium and the intact Bowman's membrane were small hyaline masses lying in the subepithelial corneal layers and partially due to degeneration of these layers. At places these masses were connected through Bowman's membrane with the epithelial thickenings. 3. At places the hyaline formations took the form of broad homogeneous elongated bodies extending through Bowman's membrane from the corneal tissue to the epithelium. These hyaline bodies stained light yellow with van Gieson's stain and reddish with eosin. 4. The epithelium was mostly normal, but here and there contained small hyaline drop-like bodies. Uhthoff suggests that this disease is a form of "lattice keratitis." The remainder of the paper is occupied by a review of published cases. There are four reproductions of microscopic sections and a diagrammatic sketch of the external appearances.

H. M. TRAQUAIR.

VI.—LIME OPACITIES OF THE CORNEA

Jickeli, C. (Heidelberg).—Experimental and clinical notes on the question of clearing of lime opacities of the cornea. (Experimenteller und klinischer Beitrag zur Frage der Aufhelbarkeit von Kalktrübungen der Hornhaut.) *Arch. f. Ophthal.*, Vol. XCI, Pt. iii, 1916.

Jickeli observed two cases of lime burn of the cornea in which the treatment recommended on chemical grounds by zur Nedden, Guillery, and Clausen was carried out. This treatment consists in the use of a solution of chloride of ammonium and tartaric acid in a proportion varying from 2 to 10 per cent. of the former and about 1/5 per cent. of the latter. In one case the result was fairly good, but in the other the opacity seemed to become worse as a result of the treatment.

To determine with more accuracy the effects of the various solutions Jickeli made carefully located triangular lime burns on the eyes of a number of animals. As a result he comes to the conclusion that lime burns produce an opacity as a result of destruction of the tissue even when the caustic has only acted for a short time, and when the presence of lime in the tissues cannot be demonstrated. When pure calcium hydroxide is employed no deposition of lime in the cornea takes place. It is, therefore, of no use to look for some chemical means of removing the opacity, based on the solution of calcium salts. No beneficial results followed the use of ammonium tartrate solutions in his experiments, and some of the solutions recommended actually caused an increase of the opacity in the previously sound part of the cornea.

A bibliography accompanies the paper.

E. E. H.

VII.—BINOCULAR METAMORPHOPSIA

Lippincott, J. A. (Monte Carlo).—**On the binocular metamorphopsia produced by optical means. (With 12 figures in the text.)** *Arch. of Ophthal.*, Vol. XLVI, No. 5, 1917.

Lippincott returns to a discussion of the changes produced in the apparent form of objects by means of various forms of glasses. He commences by discussing the principles involved in the causation of these aberrations, and particularly those relating to the estimation of distance and size. He then takes up (1) the effects of cylinders with their axes vertical, (2) the effects of spherical glasses, (3) the effects of cylinders with their axes horizontal, (4) the effects of cylinders with their axes oblique, (5) the effects of prisms on the outlines of objects, and (6) the effects of prisms on the surfaces of objects. The subject is discussed from the mathematical standpoint. The paper does not purport to discuss the anatomical and empirical theories of projection and binocular vision, apart from their bearing on the phenomena of binocular metamorphopsia. It concludes: "From a study of these phenomena, especially the spontaneous

conversion of metamophopsia into orthomorphopsia, we are led to the conclusion that retinal physiology bears no constant relation to retinal anatomy; that the directions in which images are projected by means of the same retinal elements are subject to variation, and that, for purposes of vision, the corresponding points in the two retinae which count, are those which correspond in function and not necessarily in structure. The marriage of corresponding retinal points is a loose tie, the harmony of which is easily disturbed by interposing new optical conditions, and, as sometimes happens in the social sphere, divorce and remarriage with a more sympathetic partner are effected without undue delay."

R. H. ELLIOT.

VIII.—BULLET INJURIES TO THE FIFTH NERVE

Uhthoff (Breslau).—Two cases of injury of the fifth nerve from bullet wound. (Zwei Fälle von Trigeminusläsion durch Schussverletzung.) *Klin. Monatsbl. f. Augenheilk.*, April-May, 1915, p. 391.

Uhthoff's first case was one of injury of the fifth nerve at the base of the skull by a bomb-splinter. The patient had a wound in the right temple, and the right eye remained in a condition of irritabity to external influences, becoming injected and developing slight erosions of the epithelium. A suspicion of malingering was aroused. Closer examination showed that the right cornea was somewhat insensitive and that sensation in the area supplied by the first and second divisions of the fifth nerve was greatly reduced. The nasal mucosa on the right side was slightly insensitive, and there was some loss of smell. The third division of the fifth nerve was intact. Sensation was normal in the tongue and lower part of the mouth, but impaired on the right side of the palate. Taste was impaired on the right side of the tongue. During crying or on stimulation by onions or ammonia, tears did not flow from the right eye. No marked symptoms connected with the sympathetic nerve were noted, but the right pupil was a little smaller than the left. Both, however, dilated equally with cocain. A radiogram showed a foreign body lying just in front of the Gasserian ganglion. Later some impairment of sensation appeared in the region supplied by the third nerve. Such isolated injuries of the fifth nerve are very rare. The state of the cornea is to be regarded as due to trophic disturbances dependent on the effects of wind and dust. The case also shows how careful it is necessary to be in making a diagnosis of malingering. Although the absence of secretion of tears might

appear to indicate that the secretory fibres for the lacrymal gland arise from the fifth nerve, Uhthoff believes that these fibres come from the facial system, and run along the superficial petrosal to the sphenopalatine ganglion and thence to the fifth nerve system. In this case there was probably, also, a lesion of the greater superficial petrosal nerve. The loss of taste is explained by the connection with the chorda tympani. The sympathetic nerve was, in Uhthoff's opinion, intact. The second case was one of isolated injury of the second division of the left fifth nerve with blindness of the left eye. The bullet had entered the left temple just behind the upper and outer orbital border, leaving an almost invisible scar, and emerged at the root of the neck on the right side. Immediately below the right clavicle there was another wound. The right eye had 8 D. of myopia and a myopic conus, but full vision. The left eye was almost completely blind. Movements normal; direct pupillary reaction absent, but consensual present. There were old haemorrhages in vitreous and choroid. Sensory paralysis was present in the area of the second division of the fifth nerve, including the left nasal mucosa and part of the hard palate. The upper lip, tongue, and cornea were unaffected. Smell was impaired, but taste was intact. Secretion of tears was normal on both sides. A radiogram showed a bullet in the right pectoral muscle, having evidently re-entered below the clavicle after leaving the neck.

The case provides evidence against the view that the secretory fibres for the lacrymal gland run in the second division of the trigeminus through the subcutaneous malar nerve. In spite of the myopia, the myopic conus, and the blind left eye, Uhthoff apparently did not consider the patient unfit for further military service.

Both cases are interesting on account of the light thrown upon the function of the fifth nerve, and the second in connection with the visual standard in the German Army.

H. M. TRAQUAIR.

IX.—THE ARGYLL ROBERTSON PUPIL

Dunn, J. (Richmond, Virginia).—The primary pupillary response to light an autonomic reflex. The Argyll Robertson pupil. *Arch. of Ophthal.*, Vol. XLVI, No. 3, 1917.

Dunn in this paper revives Marina's theory as to the situation of the centre for light reflex in the ciliary ganglion. He states that he has not had the opportunity of reading Marina's work, and does not know on what his theory was based. Marina (*Deutsche Zeitschr. f. Nervenheilkunde*, 1901, p. 369; 1899, p. 356) examined a large

quantity of pathological material from cases of various types, and always found marked chromatolysis in the cells of the ciliary ganglion in cases in which the light reflex was interfered with. He also made numerous ingenious experiments on animals, all of which tended to support his views. Dunn brings no new pathological or experimental evidence to support his views, and until this is done the question can hardly be regarded as settled by mere theory on centres, etc. He disagrees with the definition of the Argyll Robertson pupil as regards the loss of the consensual reflex, and says that it is not abolished, but is not called into play, since the two pupils being insensitive to light do not change their size, and there is then no necessity to keep them of the same size.

He sums up his views as follow:

"The primary response of the pupil to light is a reflex belonging to the autonomic system. That the rods represent the terminals of the fibres to the subthalamic ganglion and the cones the terminals to the anterior quadrigeminal external geniculate bodies, is a suggestion that came from consideration, first of the necessity of two sets of optic fibre terminals, and second, of the consensual reflex. Whether the suggestion be purely fanciful or not, it opens the way for a number of interesting questions and seemingly answers some of them. The Argyll Robertson pupil is the result of the abolition of the autonomic reflex of the ciliary ganglion. The suggestion that the varied picture of the Argyll Robertson pupil may be explained by the extent of the lesions within the ciliary ganglia and the subsequent degeneration therein is, I think, borne out by analogous pathology elsewhere. The contention that certain features of the optico-retinal features occurring along with the Argyll Robertson pupil in its late stages are due to degeneration of the sensory fibres from the ciliary ganglia to the ciliary region and thence, by the pigment layer to the retina will, I think, prove to be correct."

The whole question of the pupil innervation is only to be solved by more accurate neurological research work such as we may hope for from the use of such methods as Clarke's stereotaxic instrument, the latest model of which has now been sent to America for use in the Johns Hopkins laboratory. The restrictions on and lack of facilities for research work in this country have prevented the use of the instrument for any such complicated research as the investigation of pupillary centres.

E. E. H.

X.—"FLY-BLOWN" ORBIT

Barsoum, Awad (Beni-Suef).—Fly-blown orbits. *Bull. Ophthal. Soc. of Egypt*, 1917, p. 64.

It may be remembered that in 1915 an account of three cases of "fly-blown" orbit in children was published by Dr. Azer Wahba, of Zagazig (for abstract see B.J.O., 1917, p. 564) and **Barsoum** now describes three other cases, also in children. The larvae removed from Barsoum's cases were sent to Dr. Lewis Gough, who bred from them a sarcophagidal fly identified as *Wohlfartia magnifica Schinner*, which is said never to enter houses. On the other hand, in Wahba's cases the condition was due to *Cordylobia anthropophaga*.

Briefly, the details of Barsoum's cases are as follows: 1. A child of two years was affected with sloughing and much swelling of the lids of one eye. The condition gave rise to a most offensive odour, and "larvae dropped from the region of the eye as the child walked through the out-patient shelter." One hundred worms were taken away. The mesial halves of both lids were destroyed. There was a large pocket, packed with worms, between the eyeball and the nose, and two other pockets, also filled with larvae, were found, one on the upper aspect and the other on the outer side of the globe. The condition was treated by constant bathing with sublimate (1 in 5,000) and by fomentations of potassium permanganate (1 in 4,000). On the second day, the eyeball was eviscerated, and large maggots were removed from behind the globe. Child died on the third day. No autopsy. 2. A child, aged one year, had a notch, about 7·5 mm. in diameter, near the inner canthus of the right upper lid, from which five worms were picked and two others were found free in the conjunctival sac. Recovery. 3. A child of three years showed ulceration of the left orbital region near the outer canthus, and from this three pockets full of larvae extended, one towards the lower lid, a second towards the temple, and a third towards the inner canthus. Recovery.

S. S.

XI.—CHRONIC MEMBRANOUS CONJUNCTIVITIS

Stark, H. H. (El Paso, Texas).—Membranous conjunctivitis of over four years' duration. *Amer. Jl. of Ophthal.*, February, 1918.

Readers may recall the fact that three cases of chronic membranous conjunctivitis, affecting infants, were reported by

E. C. Hulme some fifty years ago (*Med. Times and Gazette*, October 31, 1863), and that similar cases have been recorded in this country by Mason, Hogg, Nettleship, Juler, Bronner, and Morton. **Stark** now recounts the case of a girl, 11 years of age, whose eyes, mouth, and throat became involved simultaneously by a bullous eruption, accompanied by fever, and appearing over the body, and finally over the face. The lids were much swollen, and there was a discharge of pus from the eyes. There were large whitish spots on the mucous membrane of the mouth and throat. The eyes were left red and "weak," and the inside of the eyelids was of whitish appearance. This condition persisted for over four years. When examined by Stark, vision was 6/6 almost. There was slight entropion of all four lids, and many cilia were missing. The conjunctiva of each lower lid showed a whitish coating, which could be removed as a complete membrane. It was re-formed within twenty-four hours. It consisted of fibrin, entangling xerosis bacilli. The author believes that erythema multiforme was the primary cause of the conjunctival condition in this case, and in support of that view quotes two cases of membranous conjunctivitis due to erythema multiforme reported by Salus in 1912. Stark found a solution of quinin sulphate (3 or 4 grains to the ounce) decidedly useful, for the membrane disappeared from one eye within four weeks and from the other within six weeks under its use. S. S.

XII.—FILARIA LOA

(1) **Cabault.—Two cases of filaria loa. (Dos casos de filaria loa.)** *Boletin de la Sociedad de Oftalmologia de Buenos Aires*, Vol. IV.

(1) Cases of filaria loa are not common in the Argentine. The author's first case occurred in a Frenchman who had spent some years in the Congo and who was in Buenos Ayres in 1913. As he was about to leave to rejoin the colours in his native country, the worm appeared under the conjunctiva, causing symptoms of irritation for which he consulted **Cabault**. The author saw the worm, but before he could get his instruments ready, it had disappeared. A few days later the man returned, this time with a worm visible and palpable under the skin of the dorsum of the hand. Efforts at removing it failed. After a week a worm appeared under the skin of the lower lid of the left eye. Cabault ingeniously fixed it with a needle and thread, piercing the skin of the lid behind the worm and extracted it easily through an excision in the skin. A few days

later the same patient presented himself with another worm under the conjunctiva of the same side. Cabault fixed it in a similar manner and extracted the caudal half of the worm, but failed to deliver the cephalic end. Examination of the patient's blood showed a large number of embryo filaria, as well as a marked eosinophilia.

Cabault's second case occurred in a French negro from Martinique who had served as a soldier in the Congo, where he had acquired the disease. In this case the worm appeared in the subconjunctival tissue, was fixed in the same manner, and removed.

Examination of the worms was carried out by Parodi, the parasitologist, and his report is appended. A beautiful plate also accompanies the paper which shows the features of the worms very well and saves a deal of descriptive letterpress.

Cabault points out that the seat of election of the filaria loa is in the superficial integuments and under the conjunctiva, in contradistinction to the filaria perstans and Demarquaii, each of which is longer and finer than the filaria loa. The embryos of the former worm have no sheath and prefer to be in the deeper structures, the mesentery and peritoneum, while the embryos of the filaria Brancrofti haunt the lymphatics, giving rise to lymphoceles and elephantiasis.

The home of filaria loa is Africa, the Guinea Coast, Angola, and, above all, the Congo. In the Argentine it is exotic. A bibliography of filaria literature completes the paper.

R. R. JAMES.

(2) **Elliot, R. H. (London).—Removal of worm (filaria loa) from the eye.** *Brit. Med. Jl.*, May 4, 1918.

(2) **Elliot** reports a case of the removal of a filaria loa from beneath the ocular conjunctiva of a patient who had contracted the disease in Benin City, West Africa, about eight years previously. Worms had been taken away from the patient's eyes on four former occasions. When examined by Elliot, the conjunctiva was congested, but no worm could be seen. After fomentations had been applied, the parasite could be recognized wriggling beneath the conjunctiva, below and close to the cornea. Cocain was applied to the eye and the lower lid pulled down. The worm tried to escape, but just as it was disappearing beneath the dense tissue of the lower fornix, an attempt was made to seize it with forceps. A needle armed with a silk suture was passed through the fold of conjunctiva held by the forceps, and after the suture had been tied tightly the instrument was removed. The opportunity was taken of anaesthetizing and blanching the parts thoroughly. On manipulating the thread, one end of the worm was seen moving freely, and was seized with conjunctival forceps. The parasite was removed through a small incision in the conjunctiva. What

appeared to be a second worm was found embedded in mucus in the lower conjunctival cul-de-sac. The larger worm was a well-grown female filaria, measuring, before it was placed in formol, 36.5 mm. The smaller specimen unfortunately was lost. S. S.

XIII.—MISCELLANEOUS

(Second Notice)

(1) **Tooker, C. W. (St. Louis).—A case of fracture at the base of the skull: ocular signs.** *Amer. Jl. of Ophthal.*, May, 1915.

(1) **Tooker's** patient was thrown out of a motor car, and struck his head against a post. He was unconscious for a day, and then noticed defect of vision in one eye. There was no sub-conjunctival haemorrhage. A skiagraph revealed fracture of the skull. The ocular lesion was optic atrophy. Vision was 13/200. Under strychnin treatment, V. improved to 13/40. The colour fields became partially restored, and a relative scotoma for white, which had been present at the beginning, disappeared. "The explanation of the improvement in vision," says the author, "probably consists in the gradual absorption and shrinking of exudates accompanying the fracture."

ERNEST THOMSON.

(2) **Detzel, L. (Freiburg i. Br.)—On the connection between Mikulicz' disease and tuberculosis of the lacrimal glands. (Ein Beitrag zur Beziehung der Mikuliczschen Erkrankung zur Tuberkulose der Tränendrusen.)** *Klin. Monatsbl. f. Augenheilk.*, September-October, 1917.

(2) **Detzel** gives notes of a case of a soldier aged 23 who had suffered from trench nephritis. This was followed by swelling of the upper lids. His blood gave a doubtful Wassermann reaction and there was a strong family history of tuberculosis. In addition to the swelling of both lacrimal glands, both sublingual glands and the cervical and axillary glands were enlarged. As no improvement followed general treatment and the eye movements were much restricted with resulting diplopia, Axenfeld removed both lacrimal glands. Inoculation experiments with the excised tissue gave no result. The microscopical appearances of sections of the glands were typical of early tuberculosis. There was no caseation, nor could any tubercle bacilli be detected.

Detzel analyses other recorded cases, and groups the cases called Mikulicz' disease as follows.—(1) Simple lymphadenoid enlargement; (2) lymphomatose infiltration; (3) chronic inflammatory process; (4) a manifestation of a tuberculous process and rarely of

a syphilitic one. As a subsidiary classification, he suggests two main groups; cases with and without blood change, further subdividing the former into genuine leukaemia and the various forms of pseudo-leukaemia, and the latter into cases with and without enlargement of the spleen and lymphatic glands.

E. E. H.

(3) **Holm, Ejler (Copenhagen).—External exudative retinitis. (Retinitis exsudativa externa.)** *Klin. Monatsbl. f. Augenheilk.*, September-October, 1917.

(3) **Holm** gives an account of ten cases of external exudative retinitis illustrated by drawings and reproductions of fields of vision. All the cases showed retinitis in the outer layers of the retina with a more or less developed subretinal exudate; in other respects there were considerable differences both clinically and ophthalmoscopically. The first two cases were typical of Coats's group 1 and the third of his group 3. The fourth and fifth cases resembled cases of retinitis circinata. The sixth case showed symmetrical exudation with haemorrhages at both maculae. Three years after these were first noticed the patient died and a pathological examination showed the typical condition of external exudative retinitis, with small perivascular foci in the retina, choroid, and orbit, consisting mainly of epithelioid cells and masses of leucocytes. This patient suffered from lymphogranulomatosis. The seventh case resembled the sixth. In the eighth case the appearances were also confined to the macular areas, but were more scar-like in character. There were no haemorrhages but some irregular pigmentation. The ninth case was that of a child of nine, and belonged to Coats's group 1. In spite of considerable exudate with retinal detachment, the vision nine years later was 6/6, and there was no defect to be found in the field. The tenth case was a child with congenital syphilis. Holm suggests that a separate syphilitic group of cases may be recognized. He would also add to Coats's classification a senile group, in which the changes are confined to the macular area, and in which the exudate is seldom prominent and has a definite limitation.

E. E. H.

OBITUARY

A great man of science, Lord Rayleigh, died at Terling Place, Witham, Essex, on June 30th, aged 76 years. In 1865 he was Senior Wrangler and Smith's Prizeman. He became in 1873 a Fellow of the Royal Society. A few years later (1879) he succeeded Clerk Maxwell as director of the Cavendish Laboratory, Cambridge,

a post that he held for five years. In 1908 Lord Rayleigh (who succeeded his father as third baron in 1873) was elected Chancellor of the University of Cambridge. In 1885 he became Secretary of the Royal Society, and twenty years later its President. He was among the first to receive the Order of Merit, when that Order was instituted in the year 1902. A couple of years afterwards he was awarded the Nobel prize for physics. Lord Rayleigh's connection with science was of a far-reaching nature. His earlier investigations dealt with the theory of sound. In conjunction with the late Sir William Ramsay he discovered argon, thereby pointing the way to a new group of monatomic gases. In 1910-11 he was a member of the Departmental Committee of the Board of Trade on sight-tests for the Mercantile Marine. Lord Rayleigh was a distinguished looking man, endowed with a pretty wit. "What is the difference between the North and the South Poles?" he is said to have asked a friend. "All the difference in the world," was Lord Rayleigh's answer. To the world at large he was known from the fact that he converted many acres of rough soil in Essex into good farming land, where he kept 1,000 cows, the produce of which helped to supply London with milk obtained from dairies conducted on scientific principles. Lord Rayleigh married first a sister of Mr. Balfour, and secondly the daughter of the second Marquis of Salisbury. He is succeeded by his son, the Hon. Robert John Strutt, F.R.S., professor of physics in the Imperial College of Science, South Kensington, well known on account of his researches into the Becquerel Rays, the origin of radium, and the measurement of geological time by radio-active data.

We regret to announce the death, at Torquay, on May 13, after a long illness, of Arthur Alison Bradburne, aged 47, once of Southport and more recently of Manchester. He was widely known as a writer, particularly on such subjects as ocular imbalance, squint, and the eyesight of children. He devised a very useful retinoscope. He was the English correspondent of the American journal, *Ophthalmology* (now defunct), and of the newly-founded Cuban periodical, *Revista Cubana de Oftalmologia*. He leaves a widow and three children.